Climate and Fire Season Severity

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Our ability to effectively and efficiently mitigate climate-related natural disasters would benefit greatly if we knew what to expect over a period of several months or a season. The ability to predict when to expect an event, or how many significant events to expect, would allow efficient mobilization of resources. In the case of wildfire, this would be the ability to plan for just enough suppression resources, placed properly for quick initial attack to keep the area burned and the size of the fire to a minimum.

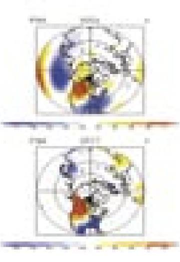
El Niño is the kind of climate anomaly that promises such predictive ability. Since the extreme El Niño event of 1982-1983, a myriad of natural disasters have been associated with the sea surface temperature anomalies in the equatorial Pacific Ocean that define the El Niño Southern Oscillation (ENSO). For the southeastern United States, the warm sea surface temperature anomalies characteristic of El Niño relate to enhanced winter precipitation with potential for flooding; however, the cold anomalies of La Niña bring far more potential for natural disasters, as it is linked to increased hurricane and tornado activity, as well as prolonged periods of drought and wildfire. In 1991, Jim Brenner of the Florida Division of Forestry discovered a strong correlation between the negative phase of ENSO (La Niña) and acreage burned by wildfires within the state. This relationship became the basis of seasonal predictions of fire season severity made by the state and used in their planning. Scott Goodrick and cooperators at Florida State University, particularly Phil Cunningham, revisited the data used by Brenner and found more interesting relationships.

In the original work, data on monthly area burned were compared to sea surface temperature anomalies over the years of 1981-1991. A linear relationship was found that indicated that cold sea surface temperature anomalies were capable of explaining approximately 50% of the variance in monthly acres burned for Florida. This relationship changed dramatically as the time series was extended

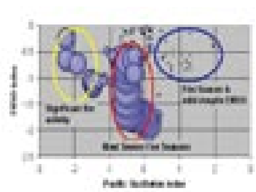
through 1999; the correlation declined, explaining less than 30% of the variance in area burned. One interpretation of this result is that the Florida Division of Forestry did a better job planning for and fighting fires by using the relationship to anticipate severe fire seasons, which led to a reduction in acres burned. A far more likely interpretation that the time series was not long enough to adequately sample a wide enough range of climate variability. This is a common problem in climate work, but the story doesn't end here.

Even though the ENSO is considered to be one of the most dominant climate oscillations (anomalies), other modes of variability exist and likely play a strong supporting role. The Pacific Decadal Oscillation (PDO) is another mode that has received a great deal of attention since the late 1990s. The PDO has a similar spatial pattern to ENSO, but differs dramatically in its temporal pattern; events last decades with PDO, rather than the 6-18 months for ENSO. The original work by Brenner focused on a period of positive PDO but the analysis of the longer time series captured a switch to a negative phase period of the PDO. Adequately accounting for variability on the time scale of the PDO, however, would require a substantially longer time series than we have used so far.

Two other modes of variability linking the Pacific Ocean to the southeastern United States are the North Pacific and Pacific North American patterns (NP and PNA). These modes exhibit much greater interannual variability than the PDO. Although these patterns differ in spatial extent, both represent a pressure dipole between the northern Pacific and the southeastern U.S. In their negative phase they act to decrease pressure in the northern Pacific while favoring the development of a ridge of high pressure over the Southeast. The relationship between high pressure and dry conditions implies that these oscillations may play a role in determining fire season severity in the Southeast. We are just beginning to unlock the relationships between climate anomalies with differing spatial and temporal patterns and their relationships to fire season severity. This diagram illustrates the relationship between Pacific teleconnection patterns (NP and PNA), ENSO, and acres burned in Florida. The size of the bubbles indicates the area burned in a season. Note that not all cold ENSO events are equal in their fire potential. To read about the original work by Jim Brenner, see Brenner, J. 1991. Southern Oscillation anomalies and their relation to Florida Wildfires. Fire Management Notes, 52(1) 28-32.



These maps show how the Pacific North American Pattern influences the atmosphere in its positive phase. Anomalies in the height of the 500 mb pressure surface (top) show below normal heights for the Southeast, which are linked to below normal temperatures (bottom).



Relationship between Pacific tele-connection patterns (NP and PNA), ENSO and acres burned in Florida (size of bubbles) showing that not all cold ENSO events are equal in their fire potential.